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Train the Trainer To Train: Dragon Instructor Certification

Georgann Lucariello and Jean L. Dyer

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The purpose of the research was to develop and evaluate a certification program for Dragon instructors. Certification materials that focused on instructors' ability to convey task content, and to identify, diagnose, and correct student errors were developed. Baseline measures of student performance and instructor behavior were obtained before the certification program was started. The same measures were obtained after instructors participated in the program.

Positive changes in student behavior occurred on three of the five Dragon tasks included in the certification program. No changes occurred on the Dragon tasks that served as controls. However, both the experimental and control tasks tested for retention 1 month after the Dragon course were forgotten quickly. Desired changes in instructor behavior were more likely on the experimental tasks than on control tasks. Correlations showed a relationship between indexes of instructor quality and student performance. Results showed that a certification program can be used to enhance the skills of instructors and to select instructors.

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Train the Trainer To Train: Dragon Instructor Certification

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Education and Training

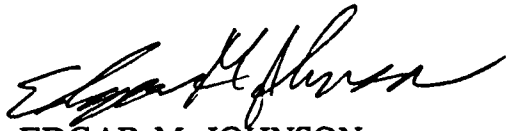
FOREWORD

Establishing and maintaining quality instruction is a continuing mission of Army training institutions. Instructor turnover makes quality control a particularly difficult and challenging task. Participation in the Trainer Development Program (TRADEP) qualification course is critical to the instructor training process. However, for weapons instruction, certification of instructors on the specific weapon taught is also critical to maintaining quality and enhancing the competence of new instructors.

This research investigated the impact of a Dragon weapons instructor certification program. The Dragon is a manportable, soldier-launched, medium-range, antitank weapon. Certification of Dragon instructors within Infantry one station unit training (OSUT) was examined. The sponsor for the research was the 29th Infantry Regiment at the U.S. Army Infantry School, and the work was conducted under the auspices of the ARI Fort Benning Field Unit. The research task that supports this mission is titled "Developing Training for Individual and Crew-Served Weapons," organized under the "Train the Force" program area.

With the assistance of the Commander, 29th Infantry Regiment, current Dragon training was observed, and a certification program and materials were developed. The implementation of the certification program and the resulting Dragon training were observed and student performance was assessed.

The findings were briefed to the Commander, 29th Infantry Regiment, the Director, Directorate of Training and Doctrine, U.S. Army Infantry School, and the Assistant Commandant, U.S. Army Infantry School. As a result, the 29th Infantry Regiment is in the process of developing instructor certification materials for all training companies using the Dragon program as the model.



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TRAIN THE TRAINER TO TRAIN: DRAGON INSTRUCTOR CERTIFICATION

EXECUTIVE SUMMARY

Requirement:

The purpose of the experiment was to evaluate the feasibility of a Dragon weapons instructor certification program. The Dragon is a manportable, medium-range, antitank weapon. A certification program for instructors of initial entry soldiers was developed and evaluated.

Procedure:

Two classes of one station unit training (OSUT) students and seven Dragon instructors were observed to establish baseline measures. Measures were student pass/fail rates, errors during practice and testing, and number of practice trials. Instructor behavior, including content delivered, training aids used, and feedback to students, was assessed.

Certification materials were developed for five of the ten tasks taught during Dragon training. The five other tasks were control tasks. Instructors, including four new Dragon instructors assigned for the experiment, received the newly developed instructor certification materials and were certified. After certification, two additional OSUT classes were observed, and the same behavioral measures on students and instructors were recorded. Additionally, to determine the retention of materials, students were tested on selected tasks 1 month after successful completion of the Dragon course.

Findings:

The certification program was successful in changing students' behavior on three of the five tasks for which special materials were developed. No changes occurred on the control tasks. Desired changes in instructor behavior were more likely on the experimental tasks than on the control tasks. On the tasks tested for retention, students forgot very quickly. Additionally, post hoc correlations showed a relationship between instructor behavior and student performance.

Utilization of Findings:

Several curriculum deficiencies identified during certification led to changes in the Dragon program of instruction. The 29th Infantry Regiment has planned a regiment-wide weapons instructor certification program using the Dragon research as a model.

TRAIN THE TRAINER TO TRAIN: DRAGON INSTRUCTOR CERTIFICATION

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TRAIN THE TRAINER TO TRAIN: DRAGON INSTRUCTOR CERTIFICATION

Introduction

According to FM 25-100, Training the Force (Department of the Army (DA), 1988), training is the cornerstone of success on the battlefield. The combat mission requires the Army to provide trained, combat-ready forces for prompt and sustained military operations.

The training philosophy of the Army involves both the individual and the leader. It is the soldier's responsibility to learn, perform and become proficient. However, the soldier must be given the opportunity to learn, grow and mature. This process is facilitated by worthwhile goals, clearly defined standards and competent noncommissioned officers (NCOs) who teach and train. Leaders, on the other hand, set objectives, plan, execute, and evaluate training, and then correct deficiencies and reinforce strengths (DA, 1988).

Learning and Instruction

Ideally, instruction should be based on what is known about how individuals learn, and the instructional procedures or events that facilitate learning and retention. Gagne's (1977) concepts of learning and instruction were used as a model to develop the instructional materials in the present research. Learning occurs when a stimulus situation (e.g., instruction), in combination with the learner's memory, affects the learner. The learner's performance changes from what it was prior to being in the stimulus situation. From an instructional perspective, the change in performance or learning must be retained across time. Learning is attributed to the situation, and is not a result of growth or maturation.

According to Gagne (1977), learning occurs in several successive phases, which are directly related to instructional events. The motivation phase of learning is enhanced through intrinsic and extrinsic motivation as well as by informing the learner of the objective. The apprehending phase is facilitated by directing the learner's attention to the task. This is accomplished by putting the learner in a ready mode (e.g., posture and muscular tone in a readiness state) or emphasizing distinct aspects of a presentation (e.g., highlighting, underlining, etc.), so the learner attends to the stimuli to be stored and processed in short-term memory. Acquisition is characterized by providing the learner with information to be stored in long-term memory through stimulating recall and guiding the encoding process. The retention, recall and generalization phases are enhanced by providing the learner with cues for retrieval and a varied environment in which to apply the learned material or task. The performance phase is characterized by the learner's ability to perform the new task, as well as being appraised in a test environment. Finally, the feedback phase, closely tied to the performance phase, informs the learner of the correctness of the performance.

The instructor is the manager of the conditions of learning, controlling instructional events such as gaining attention, informing the learner of expected outcomes, stimulating recall of relevant prerequisite knowledge and skills, presenting

stimuli inherent to learning the task, determining the extent to which errors are minimized, and providing corrective feedback. The instructor's expertise in managing these instructional events influences the learner's performance.

Army Training and Instructor Preparation

The Army training environment differs from traditional learning environments. In some cases, Gagne's (1977) learning phases are not facilitated by coinciding instructional events during training because of the nature of the task. Task elements often are distinct. There may be very little transfer from tasks previously learned. For example, with the M16 rifle the soldier is taught to lead center-of-mass of the target when it is moving. The Dragon gunner must, however, stay center-of-mass at all times and track the target until impact. Even within a weapons course, there may be little transfer among tasks. In fact, there is often interfering information. For example, the lens cleaning procedure for the Dragon day tracker is a circular motion, while the night tracker cleaning procedure is a back and forth motion.

During initial training, soldiers must often learn a variety of distinct tasks within a relatively short period of time. Training on a weapon can be a series of short blocks of instruction (two to eight hours) distributed over several weeks when the soldier is learning many other nonweapon tasks, as is the case with M16 rifle instruction, or one week devoted to a system such as the Dragon.

Preparation of instructors also differs from the traditional process. Army preparation is considerably shorter than that provided public school teachers. Training, such as the Trainer Development Program (TRADEP), typically focuses on general methods of instruction. Subject matter knowledge is assumed, although expertise is frequently acquired through on-the-job training, rather than formal education. Instructor training which focuses on skills particularly relevant to the subject matter taught (e.g., use of weapon training devices, problem-solving skills) may not exist.

Although the Army requires instructors to receive training prior to teaching, there are aspects of student achievement and teacher effectiveness cited in reviews by Brophy and Good (1986) and Harrison (1987) which are not always applicable to an Army training environment. For example, instructor selection is not necessarily based on knowledge or expertise; it is often based on filling an open position. Thus, the most capable instructor may not be in the slot which best uses his or her skills. Additionally, instructor stability is not optimal.

The military environment must be considered in generalizing from research on teacher effectiveness in traditional settings. Although some variables found to be related to instructor effectiveness may apply to the military setting, others may not. For example, Berliner (1987) cited eight instructional variables which were related consistently to student achievement in traditional elementary school learning environments. The variables were:

- Effective teachers clearly informed students of what, where, and for how long tasks were to be done.

- Effective teachers and students were rarely absent from school.
- An academic focus yielded consistently higher achievement.
- The more content covered, the higher the achievement.
- Careful monitoring of students to ensure task completion yielded greater achievement.
- Factual rather than abstract questions yielded higher achievement in basic skills.
- Academic feedback correlated positively with achievement.
- A warm, democratic environment resulted in higher achievement.

Student absentee rates are of little concern within many military settings. On the other hand, informing students of training objectives, monitoring student performance, and covering the subject matter content are, presumably, quite relevant.

In a review of process-product literature, Brophy and Good (1986) summarized Stallings, Cory, Fairweather, and Needels' findings from junior and senior high reading classes, and concluded that, when measuring achievement, the quality of instruction was the key correlate. Additional correlates were instructing small or large groups, reviewing assignments, praising success, and providing corrective feedback when errors occurred. Student achievement was adversely effected when teachers did not interact with students, when the students worked independently, and when time was lost to outside intrusions. Brophy and Good also concluded from Brophy's work that some teachers consistently produced superior student achievement over other teachers. The essence of the review was that "Improvement of education must begin with recruitment of capable teachers, followed by retention of those teachers in the teacher role. Preservice and in-service teacher education in both subject matter and pedagogy are also essential" (p. 370).

The present research focused on the effectiveness of an in-service training program. It was completed in an effort to maximize the effectiveness of soldiers currently assigned as Army instructors, and the resulting student behavior. Specifically, it was designed to evaluate a pilot instructor certification program in the U.S. Army Infantry School (USAIS). The Dragon weapon system course within one station unit training (OSUT) was used as the test case for the evaluation. The Dragon course was selected for several reasons. It consists of one week of instruction, allowing for a manageable training schedule. Instruction is given by range instructors with little assistance from drill sergeants. Students are evaluated on all tasks taught. Lastly, the NCO cadre had compiled preliminary certification materials, which supplied a framework for the experimental program.

OSUT Dragon Training

The Dragon is a one-man portable, soldier-launched, medium-range, antitank weapon. The OSUT Dragon program of instruction (POI) is a 40 hour week of instruction. Upon successful completion of the course, an additional skill identifier (ASI) of C2 is awarded to the soldier's military occupational specialty (MOS) of 11B (Infantryman). During this week, soldiers are instructed by range NCOs on ten tasks. The tasks are Prepare for Firing, Determine Target Engageability, Perform Malfunction Procedures, Prepare an Antiarmor Range Card, Maintain Day Tracker and Round, Operate the AN/TAS-5 (night tracker), Demonstrate a Firing Position, Prepare a

Fighting Position, Restore to Carry Configuration, and Engage Targets (DA, 1989a). Engage Targets is performed on the launch effects trainer (LET), a training device which simulates the launch effects of the Dragon and allows the student to develop the tracking skills needed to successfully engage a target.

Instruction occurs in a small group format in a ratio of approximately one instructor to four students. During the course of the week, the instructor remains with the same four students. Students are given 20 practice trials on the LET from both the sitting and standing supported firing positions. Qualification trials follow the practice trials. LET instruction is conducted during the first two to three days of the week. For each of the other tasks, the instructor provides an explanation and/or demonstration. Students are allowed time to practice, and are then tested on the task. If a student fails to meet the performance criteria, more practice time is given, and the student is immediately retested. If a second failure occurs, the student is retested after a 24 hour period. After the initial testing and retesting on one task have occurred, the next task is presented. The tasks are presented in a specific order, but the order can be changed based on instructor or student needs or problems. Normally, all instruction occurs outdoors.

Except for LET qualification, each student must successfully perform all tasks in three attempts. To qualify on the LET, 16 hits out of 20 attempts from both the sitting and standing supported firing positions, for a total score of 32 hits out of 40 attempts, must be achieved. If this standard is not met on the first attempt, there is one retest per firing position. The student who scores the highest LET qualification on the first 40 rounds fired and does not fail any attempts on the other tasks is the "top gun" of the class, and fires an inert training round on the last day of class.

Current Dragon Instructor Certification

When a soldier is assigned as a Dragon instructor, several steps must be completed to become a certified instructor. If the instructor has taken the USAIS TRADEP qualification course, a Dragon class in OSUT must be attended. After successfully completing the Dragon course, the instructor becomes an assistant to another instructor, setting up training equipment, and gradually taking over the responsibilities of the mentor. When the NCOIC (NCO in charge) perceives that the new instructor is ready to teach, a "murder board" (instructor critique) on all the tasks must be passed. Only then is the new instructor allowed to instruct students. This process takes approximately six to eight weeks.

If the newly assigned instructor is not TRADEP qualified, either the TRADEP course or OSUT training is attended. After one course is completed successfully, the other course is completed.

The NCOIC master trainer recertifies all Dragon instructors annually. To be recertified, the instructor must perform all the Dragon tasks successfully, and present instruction on one Dragon task to the NCOIC master trainer. The instructor has no performance standard, and thus has unlimited trials to successfully complete recertification.

Experimental Dragon Instructor Certification

The instructor certification program in the present experiment was similar to that described above. Prior to the research, the cadre responsible for OSUT Dragon instruction wrote an instructor training and certification program (DA, 1989b) for Dragon instructors. The first part of this certification program covered personal qualifications and TRADEP certification. Part two consisted of the instructor training (student POI) section which outlined the tasks on which an instructor must be proficient. Part three was an expansion of the annual recertification program. It contained training and coaching techniques sections, and performance evaluation. New instructor training materials and evaluation procedures were developed by the Army Research Institute for this part of the certification program. The effectiveness of these materials was the focus of the research.

Research Questions

Three research questions were addressed. First, did the instruction of Dragon instructors differ after participation in the certification course? Second, did student performance change after instructors had taken the certification course? Finally, if there were differences in either instructor behavior or student performance, did they occur for all Dragon tasks or only for the five tasks in the certification course?

Procedures

The research was conducted in three phases. The pre-certification phase consisted of collecting two weeks (two different Dragon classes) of baseline data. Two weeks were then devoted to instructor certification. The post-certification phase was two weeks (two different Dragon classes) of data collection after instructors went through the certification phase. Data were also obtained on the retention of Dragon tasks one month after the students qualified as Dragon gunners.

Instructors

Instructors were assigned to one of three groups. Group A consisted of four current Dragon instructors who participated in all three phases. Group B consisted of three current Dragon instructors who were observed only during the pre-certification phase. Group C was four TRADEP qualified instructors who were not Dragon instructors. They received Dragon OSUT training during the first week of pre-certification data collection, acted as assistant instructors during the second week of pre-certification, received certification training, and were observed as instructors during the post-certification phase.

Students

Four weeks of OSUT Dragon classes were observed, making a total of 104 students. General technical (GT) aptitude area scores were recorded for all students.

A one-way analysis of variance (ANOVA) comparing the four Dragon classes showed no significant differences in general ability. The average GT score was 105 with a standard deviation of 12.3.

Observers

There were seven primary observers. Five were senior NCOs (TRADEP qualified) assigned to the research project. Two observers were research psychologists. Additionally, five substitute observers made 2% of the observations. Observers received four days of training. During this time, they reviewed the instructor training materials, the observation forms and instructor evaluation forms. They spent one day on the range observing training, and recording instructor and student behavior prior to the start of data collection.

Pre- and Post-Certification Phases

Each observer was assigned to one instructor and approximately four students each week. No observer/instructor pair was duplicated during the research. Observation forms to record student and instructor behavior were developed for all instructional blocks. A complete set of these materials is in Lucariello, Dyer, and Purvis (in preparation).

Instructor observations. For each task taught, the observer recorded instruction start and stop times, total practice time given to the students, and whether the task components (as defined in the student handout, DA, 1989a) were taught. For all tasks except the LET, additional information was collected on the method of instruction (e.g., feedback given, memory cues used, training aids), plus unusual events during training. The overall student pass/fail rate was recorded. A core set of five questions asked if the instructor used the same terminology throughout instruction, immediately corrected errors during practice, used training aids, used memory cues, and stressed critical points. Additionally, there were questions specific to a task (see Appendix A for a sample observation form).

During LET practice and qualification, eight specific instructor behaviors were recorded (see Appendix B). The measures reflected the instructor's interaction with each student before, during, and after each firing. The before firing measures were whether the instructor watched the student, and whether feedback or guidance was provided as the student prepared to fire. During each LET track, observers recorded whether the instructor watched the student, whether feedback was given about the firing position (e.g., keep eye in the eyepiece, lean more to the left, keep elbows together), and/or whether the instructor watched the indicator meter or "gyro" on the LET device. The indicator meter provides a continuous update of the student's aimpoint in the horizontal and vertical planes, thus simulating the missile flight pattern. Upon completion of an engagement, the observers recorded whether the instructor told the student the results of the trial (hit or miss the target vehicle) and the final indicator meter (aiming) score. In addition, if a miss occurred, the instructor could indicate the time during missile flight when tracking errors were made.

The observation instruments stressed behaviors used in previous teacher-effectiveness and process-product research (e.g., Good & Grouws, 1977). Engaged time (Berliner, 1979), defined as the time students attended to the subject matter, was recorded. Most of the other behavior observed could be categorized as low-inference descriptions of teacher-student interactions (e.g., did the instructor use a particular training aid or did the instructor define certain terms or stress a particular sequence to be followed?). High-inference descriptions were not required (e.g., did the instructor present the material clearly?).

Student observations. The students were observed as they practiced each task. The number of practice trials and errors were recorded. Additionally, students were observed when tested. Qualification errors and pass/fail performances were scored. A similar format was used for all tasks except the LET firings (see Appendix C for a sample student observation form).

Student behavior on the LET was recorded on the same form used for instructor behavior (Appendix B). The student's hit/miss and final indicator meter score data were recorded. Additionally, the direction in which the target vehicle was moving was noted.

Certification Phase

First week. During the first week of certification, the instructors were required to perform the nine gunner tasks, and qualify on the LET. This constituted an assessment of their ability as Dragon gunners. During this time, the instructors also received the experimental certification materials. One afternoon was allocated for explanation of the materials.

Experimental instructor training and test materials were developed for five of the ten Dragon tasks: Prepare the Dragon for Firing, Determine Target Engageability, Perform Malfunction Procedures, Prepare an Antiarmor Range Card, and Engage Targets. These tasks were selected because they represented the different types of knowledge and procedures a student needs to pass the Dragon course. The principles underlying these materials were based on the Gagne-Briggs' theory of instruction (Petry, Mouton & Riegeluth, 1987). They stressed the value of practice in acquiring a skill, the importance of instructor feedback during skill acquisition, the value of memory cues and strategies for remembering, and procedures for ensuring students understand the task or skill. For some of these tasks, training aids were also developed. All certification training and testing materials are in Lucariello, et al., (1990). Control tasks, for which no materials were developed, were: Maintain Day Tracker and Round, Operate the AN/TAS-5 (night tracker), Demonstrate a Firing Position, Construct a Fighting Position, and Restore System to Carry Configuration.

Prepare the Dragon for Firing requires the student to perform sequentially the steps needed to proceed from carrying the Dragon round and day tracker separately to assuming a firing position with the system assembled. The certification materials stressed providing a good demonstration of all steps, allowing each student time to practice the task, providing corrective feedback

whenever errors occurred, and explaining why critical steps must be performed. Because this task is the student's first introduction to the parts of the Dragon, the instructor was told to be consistent when identifying them.

In Target Engageability, two distinct task parts are performed: determine if the vehicle is in or out of range using the Dragon stadia lines (requires applying one of two rules), and if it is in range, determine whether or not it is engageable using the Dragon sight picture (one rule). The certification materials stressed the key concepts included in each rule, clear presentation of the rule prior to presentation of examples, student practice on a variety of examples to ensure generality of the rules, and the importance of providing immediate feedback. Training aids developed for this task allowed students to practice without using the Dragon system, and allowed the instructor to observe the student's use of the stadia lines and sight picture.

Malfunction Procedures are performed to determine if a round has misfired or is a hangfire. It is a procedural task with non-inherent task elements. That is, the student must pretend to feel a cold or hot battery, and verbalize the steps of replacing the round and tracker, depending on the status of the battery. As taught and tested, the task consists of approximately 50 steps. The certification materials were designed to help the instructor divide the task into its logical components, so students would find it easier to learn and retain.

Prepare an Antiarmor Range Card is a paper and pencil task which requires the student to recall and portray a sector of fire and all its parts. Additionally, the student must possess compass (e.g., determine a back azimuth) and mathematical (e.g., determine distance and intervals) skills. The certification materials stressed defining range card concepts and acronyms, reviewing rules learned in previous instruction applicable to the range card, preparing several different range cards to ensure mastery of basic concepts instead of memorization of one situation, and providing corrective feedback to students after each trial. The training materials for this task are at Appendix D.

Engage Targets with the LET is the task which determines whether a student will be qualified as an "expert" or "1st class" gunner. The LET simulates launch and flight characteristics of the Dragon system. Successful firing of the Dragon requires that a gunner not be distracted by launch characteristics such as weight shift and noise, and maintain a smooth track throughout missile flight. Because the firing position affects the reaction to missile launch, the instructors were given key points to stress about the proper position, and student behaviors to observe throughout LET practice that reflected deviations from this position. In addition, because the LET does not provide direct feedback to the student, including whether the target was hit, immediate correction of errors was emphasized, and ways in which the instructors could improve feedback to the students were suggested.

Second week. The second week was devoted to assessing the instructors' teaching skills. The evaluation focused on the instructor's ability to instruct, as well as the ability

to identify, diagnose and correct student errors. Error assessment and corrective feedback were judged to be particularly important given the types of tasks and skills taught. In addition, the requirement to produce qualified gunners within a very short time period increased the need for timely and appropriate feedback.

Each instructor taught all five experimental tasks. To assess the ability to teach, the task information from the student handout (DA, 1989a) was reorganized into a checklist format. Other company cadre were used as assistants, role-playing as students. The instructor received a "GO" if the material on the checklist was covered during the presentation, and a "NOGO" if it was not.

To determine the instructor's ability to identify, diagnose and correct errors, the role-playing cadre deliberately made the errors specified in the test materials. When a mistake was made, the instructor then had to provide the appropriate corrective feedback, as cited in the test materials. Additionally, Determine Target Engageability and Range Card were tested in a paper and pencil format (see Appendix E).

Instructors were allowed two trials per task to meet the standards established for each part of the evaluation. The NCOIC master trainers tested each instructor. During certification, the observers watched instruction as they had during pre-certification, recording the information the instructor stated or neglected to state.

Retention

Retention of Dragon tasks was assessed prior to the students' OSUT graduation. The retention interval was three weeks for three of the classes, and four weeks for the other class. Only students who passed the course were tested. The four tasks tested were: Prepare an Antiarmor Range Card, Prepare for Firing, Perform Malfunction Procedures, and Maintain Day Tracker and Round. Students were not told they would be retested, and the OSUT instruction they received after passing the Dragon course did not pertain to the Dragon weapon system. The same instructions and performance standards were required of each gunner as during Dragon training. However, the gunner received only one trial, and was not stopped when an error was made. Testers were Dragon instructors. After each performance, the instructor provided feedback.

Results

Instructor Certification

Table 1 summarizes the extent to which instructors presented the required content on the experimental tasks during certification instruction. The current NCOs (Group A) tended to cover more of the items on the student handout than new Dragon instructors (Group C), except during Range Card and LET Firing. A possible explanation for the Range Card is that it was such a difficult task to teach that the new instructors may have devoted more time to learning the components, while the current instructors felt confident in their knowledge, and overlooked parts. A similar rationale may explain the LET results.

Table 1

Instructor Certification: Percentage of Content Presented by Instructors on Experimental Tasks

	Certification Task				
Group*	Engageability	Malfunctions	Range Card	Prepare	LET Firing
Group A Range NCOs	92.6	98.4	88.5	99.0	63.9
Group C New Instructors	80.1	87.1	93.7	81.4	87.5

*n = 4 for each group.
Note. Percentages were based on 23 items for Engagability, 63 for Malfunctions, 13 for Range Card, 35 for Prepare, and 18 for LET Firing.

The second part of the certification process required the instructor to identify student errors, determine the causes, and make appropriate student corrections. Table 2 shows results for this part of the evaluation. Except for LET Firing, the current instructors were able to assess errors more effectively and were more likely to provide the appropriate feedback than the new instructors. The overall performance of the new instructors on this aspect of teaching was low.

Analysis of Instructor and Student Data

Due to unexpected events during execution of the research, it was not possible to isolate the variability associated with each instructor. Class sizes were not full, and the complement of eight instructors was not always necessary. Some unexpected attrition of instructors occurred. Finally, due to extremely cold weather one week, some tasks were taught in a large group rather than in small groups. Thus the original design of having eight instructors teach each task to four students each week was compromised.

The analyses compared data obtained prior to instructor certification to that obtained after instructor certification. When student results were examined, the pre-post certification analyses were based on different students. However, this was not the case for the instructor data. Half the instructors in the pre- and post-certification groups were the same (Group A as defined in the Procedures section). These instructors were part of every phase of the research. The remaining pre-certification instructors were the other current NCOs on the range (Group B) who never received certification training.

Table 2

Instructor Certification: Instructor Scores on Identifying Student Errors and Providing Corrective Feedback on Experimental Tasks (% Incorrect Responses)

	Certification Task				
Group*	Engageability	Malfunctions	Range Card	Prepare	LET Firing
Group A Range NCOs	0.0	6.9	10.7	31.7	10.7
Group C New Instructors	39.3	20.8	48.2	43.3	12.5

*n = 4 for each group.
Note. Percentages were based on 22 items for Engageability, 18 for Malfunctions, 28 for Range Card, 15 for Prepare, and 14 for LET Firing.

The other post-certification instructors were new instructors who received certification training (Group C). The pre-and post-certification instructor comparisons are conservative estimates of effects due to the fact that the variable of instructor could not be covaried in the analyses. Pre-post effects should not be the result of Group A instructors since they constituted half the instructors during both certification phases.

Instructor Behavior

Instructional time. In general, there was an increase in total instructional time (instructor presentation plus student practice) after certification on the experimental tasks. Time devoted to each experimental task increased, resulting in an average increase of 34% Time increased the most on Malfunctions (70%), while Range card time increased the least (20%). The average instructional time for the control tasks increased by 7%. Changes in instructional time on control tasks ranged from an increase of 28% for Maintain to a decrease of 10% for both Restore and Firing Position. Actual times are in Table 7 of Appendix F. LET instruction was excluded from this analysis because the length of the LET firings was controlled by the target vehicle, not the individual instructor.

Content presented. Across all experimental tasks, including the initial LET instruction, the instructors presented almost all the required material. The percentage of content items covered was extremely high on the experimental tasks and did not vary from the pre- to post-certification phases (M = 94% for pre- and post-certification).

Although the amount of content covered was lower for the control tasks, the percent did not vary from pre- to post-certification (M = 87%). Percentages for each task are in Table 8 in Appendix F.

Instructional Techniques. The five instructional techniques common to the instructor observations were examined for pre-post differences. Across all tasks and instructors there was a 5.2% increase in use of these techniques. However, the experimental tasks were more likely to be above the mean increase of 5% (Table 3). The average increase for the experimental tasks was 12% (from 69% to 81%). No overall change occurred during instruction on control tasks (72% for pre- and post-certification). On the experimental tasks, the greatest increase in the five instructional techniques occurred when teaching students how to determine target Engageability (29%), with Range Card and Malfunction instruction each having a 7% increase. Over all experimental tasks, the increases were in use of three techniques: memory cues (25%), corrective feedback (17%), and emphasis upon key points (12%). Complete data are in Table 9 in Appendix F.

Table 3

Pre- to Post-Certification Changes in Instructor Use of Critical Techniques

Task	Below Mean	Above Mean
Experimental	Prepare	Engageability Malfunctions Range Card
Control	Restore AN/TAS-5 Fighting Position* Firing Position*	Maintain

* Decrease from pre- to post-certification.
Note. Mean percentage increase was 5.2%. The five critical techniques were use of same terminology, immediate correction of errors, use of training aids, use of memory cues, and emphasis of critical points.

Some techniques were used more frequently than others, regardless of task or certification phase. Instructors almost always used the same terms within a block of instruction (average of 99% on experimental tasks; 96% on control). In addition, instructors usually corrected errors immediately, used training aids, and emphasized key or critical points (average of 77% on experimental and control tasks). On the other hand, memory cues were given infrequently (average of 44% on experimental tasks; 33% on control). Great variability also occurred on this variable, with the percentage ranging from 0% to 100% when individual tasks were considered. For example, use of memory

cues during instruction on Engageability increased from 23% to 100% from pre- to post-certification, while it stayed at approximately 10% on Malfunctions.

Observers also recorded the incidence of instructional procedures unique to tasks. These behaviors included definition of critical terms, application of content-specific techniques stressed in the certification materials, and emphasis on critical procedural steps. The greatest change occurred in the use of the night tracker training aid during Engageability instruction. No training aid existed prior to certification. After certification the aid provided in the training materials was used 69% of the time. Complete data on the use of specific instructional procedures are in Table 10 in Appendix F.

LET instruction. Pre-post certification differences in instructor behavior, as well as differences which were a function of practice and qualification trials, were of interest during LET instruction. It was assumed that instructor feedback and guidance would decrease during qualification firings, since these firings constituted a test. However, since the LET does not provide any direct feedback to the student, no change was expected on instructor hit-miss feedback.

Each instructor behavior observed during LET training was analyzed with a two-way ANOVA (pre-post by LET block). Pre-post certification was treated as a between-subjects variable. All 80 LET trials (practice and qualification) were divided into eight blocks of ten trials each, creating a within-subjects factor with eight levels. The first four blocks (first 40 trials) were practice; the last four blocks, qualification. Within the practice and qualification trials, the firing positions and target vehicle movement followed a pre-defined sequence. A set of orthogonal planned contasts was used to examine the block and pre-post by block interaction effects with the multivariate t-method (Kirk, 1968; Milliken & Johnson, 1984). The contrast of interest compared the average of the practice trials to the average of the qualification trials. Complete instructional data were available on all 80 LET trials for 100 students; 50 within each certification phase. Table 4 presents means for the practice and qualification trials, and the pre- and post-certification phases. ANOVA tables are in Appendix G.

As expected, on all instructor variables except hit-miss feedback, more instructor-student interaction occurred during practice than qualification trials. Instructors provided hit-miss feedback on at least 85% of the LET practice and qualification trials.

There were pre- and post-certification differences on three of the eight LET variables. After certification, instructors were more likely to give students feedback on their firing position during tracking, and on whether they hit the target than prior to certification. After certification, instructors were less likely to give students feedback on their final aiming score. However, this difference between pre- and post-certification occurred only during practice trials. One other significant effect occurred with the pre-post and practice-qualification contrast. This involved aiming feedback during tracking. Minimal pre-post differences existed on this variable during practice, while during qualification pre-certification feedback dropped more than post-certification feedback (see Appendix G).

Table 4

Means on Instructor Behaviors during LET Training

Phase	Firing Trial[a]		Certification	
Instructor Behavior	Practice	Qualify	Pre	Post
Watch Student before Firing	6.9	4.2	5.1	6.0
Feedback before Firing	6.6	2.2	4.2	4.6
Watch Student during Tracking	4.4	2.1	3.2	3.4
Feedback on Position during Tracking	5.5	2.8	3.6	4.8[b]
Feedback on Aiming during Tracking	4.2	2.6	2.9	3.9
Feedback on Aiming after Firing/Tracking	1.8	0.4	1.4	0.8[d]
Feedback on Tracking Error (if Target Miss)	2.4	0.9	1.8	1.6
Inform Student of Target Hit or Miss	8.6	8.7	7.9	9.4[c]

Note. Means can be interpreted as the average number of times a behavior occurred during a block of 10 trials, or as a percentage of trials. For example, on the target hit-miss feedback variable, a mean of 8 would indicate that, on the average, instructors told students if they hit or missed the target on 8 of 10 trials, or on 80% of the trials.

[a] Practice means significantly higher than qualification means on all variables except hit/miss (see Appendix G).

[b] $F(1,98) = 5.39$, $p < .02$ for pre vs post

[c] $F(1,98) = 12.48$, $p < .0006$ for pre vs post

[d] $F(1,98) = 6.16$, $p < .01$ for pre vs post; $F(7,686) = 2.50$, $p < .02$) for interaction

Student Behavior

Experimental and control tasks. Student performance categories were collapsed to two categories: students who passed on the first trial and those who did not. Two of the five experimental tasks had statistically significant pre- to post-certification differences on percentage passing on the first trials (see Table 5). Prepare for Firing showed a 27% increase from pre- to post-certification and Engageability had a 23% increase on first trial passing. There were no statistically significant pre-post certification differences on first-trial GOs for the control tasks.

Because the proponent was interested in the quality of testing, each observer used the POI task checklist to indicate whether students passed on the first qualification trial. Except for the Fighting Position task, observers disagreed with the instructors to some degree. Discrepancies occurred because observers thought some students should not

Table 5

Percentage of Students in Pre- and Post-Certification Groups Passing on First Qualification Trial

Task	N	Pre %	Post %	Post-Pre Difference	X^{2a}	p
Experimental						
Prepare	104	69	96	+27	13.13	.000
Engageability	103	53	76	+23	6.00	.014
Malfunctions	104	69	80	+11	1.78	.182
Range Card	95	45	43	-2	0.06	.813
LET - Stand	100	81	90	+9	1.52	.217
LET - Sit	103	83	84	+1	0.00	.963
Control						
Restore	104	85	96	+11	3.49	.062
Maintain	104	80	84	+4	0.33	.546
Firing Position	103	96	96	0	0.00	.953
Fighting Position	95	83	79	-4	0.20	.654
AN/TAS-5	93	88	80	-8	1.16	.282

[a] df = 1.

have been passed on the first attempt; instructors did not test all task steps and/or did not detect student errors. Of the 44 scoring discrepancies, 80% occurred on the control tasks of Prepare, Firing Position, AN/TAS-5, and Maintain. A separate analysis was made of the percentage of students passing on the first qualification trial using the observer scores. Although first-trial GO percentages were lower than the instructor scores, the Chi-square results were the same. Prepare and Engageability percentages were higher after certification.

In addition to the first-trial GO analyses conducted on LET qualification, analyses were conducted on practice and qualification scores obtained from each firing position. The maximum possible score was 20 for each condition. A one-way ANOVA was conducted comparing the pre- and post-certification groups on each score. A significant difference in favor of the post-certification group was found only on practice shots from the standing supported position ($F(1,101) = 6.65$, $p<.01$; $M_{Pre} = 14$ and $M_{Post} = 15.7$).

Retention. Four tasks were performed by students who had passed the course three to four weeks previously. Of these 87 students, 89% were tested for retention. Due to a scoring error, the data on Maintain for one class were eliminated from the

APPENDIX A

EXAMPLE OF DRAGON INSTRUCTOR OBSERVATION FORM

Instructor: _____ Observer: _____ Date: _____

MAINTAIN THE M47 MEDIUM ANTITANK WEAPON SYSTEM

Time instruction started: _____ Time instruction ended: _____
Time practice started: _____ Time practice ended: _____

Taught			Content	Student Summary (test) GO			NOGO		
	Y	N		1	2	3	1	2	3
1			TRACKER: Check external surfaces for oil, dirt, grease, damage.						
2			Clean metal parts with dry clean cloth.						
3			Clean rubber or synthetic parts with detergent and water.						
4			Report damaged or outdated items to supervisor.						
5			Inspect shock absorbers to insure they are present, tight, and not damaged.						
6			INSPECT LENSES: If dirty, clean with lens brush.						
7			If still dirty, use lens tissue, wood dowel and ethyl alcohol.						
8			PROCEDURE FOR CLEANING: Check trigger lever to ensure will operate only when safety is pressed.						
9			Check for tears and dry rot.						
10			Do not check trigger lever when mated.						
11			Check metallic click.						
12			INSPECT EYE GUARD: Cracks, visible damage, and secure fit which allows rotation.						
13			Eye guard rotates independently from focus ring.						
14			LOOK THROUGH SIGHT: Rotate focus adjustment ring to left and right.						

	Taught		Content	GO			NOGO		
	Y	N		1	2	3	1	2	3
15			Ensure visible focusing of reticle and target.						
16			ELECTRICAL CONNECTOR COVER: Check for damage and secure fit.						
17			Check rubber cushion.						
18			Inspect access cover for loose screws (10) or damage.						
19			Inspect guide pins (4) for physical damage.						
20			ROUND: Check humidity indicator; should be blue.						
21			Check forward and aft shock absorber for loose cushions cracks or visible damage.						
22			Check exterior surface for oil, dirt, grease.						
23			Inspect the launcher tube for gouges, cracks, punctures. Clean if necessary.						
24			Inspect tracker support assembly for damage and firm fit of cover on electrical connector.						
25			Inspect electrical connector for damage.						
26			Inspect raceway conduit surface for dents, cracks or other damage.						
27			Check electrical cable nipple and two terminals.						
28			Inspect tracker battery for dents, punctures, cracks and that it is secure.						
29			Inspect carrying sling for rips, tears, etc. so it will support weight of round.						
30			Inspect bipod for damage.						
31			Do not unsnap the retaining strap during the preoperational inspection.						
32			INSPECT ROUND FOR LEGIBLE MARKINGS: Blue for training, black and yellow for high explosive, brown for back blast.						
33			Data plate (16 years).						

34. List other material taught, but not listed above.

Definition of terms:

35 Y/N Raceway conduit
36 Y/N Cable nipple
37 Y/N Cable terminals
38 Y/N Guide pin
39 Y/N Focus adjustment ring
40 Y/N Electrical connector
41 Y/N Access cover
42 Y/N Humidity indicator

43 Y/N Instructor used student handout as a training aid.
44 Y/N Instructor used other training aids (handouts, tracker, FHT).
List:

45 Y/N Instructor called on each student during practice.
46 Y/N Instructor used the same terms throughout instruction.
47 Y/N Instructor emphasized sequence.
48 Y/N Instructor immediately corrected errors during practice.
49 Y/N Instructor gave initial demonstration of task.
50 Y/N Instructor talked student through initial demonstration of task.
51 Y/N Key points were stressed.
If so, what?

52 Y/N Memory cues were used (DOG = dirt, oil, grease).
List:

53 Y/N A specific order was specified.
54 Y/N Instructor asked if students had questions.
55 Y/N There were student questions.
List:

APPENDIX B

INSTRUCTOR AND STUDENT OBSERVATION FORM FOR LET FIRINGS

LET FIRING
INSTRUCTOR AND STUDENT PERFORMANCE

Date:___________________
Instructor:___________________ Observer:__________

= =

Student:______________ Practice or Test (Circle)

Time Block Started:___________ Time Block Ended:___________
Target Scenario (Circle): Moving/Stationary 10/5/2 seconds
Firing Position: Standing supported / Sitting

[Observer - number the trial for each student and circle the appropriate answer. Circle any trial number when the LET was not charged.]

#	INSTRUCTOR Before Watch Gunr	Before Fdbk	During Watch Gunr	During Fdbk Gunr	During Fdbk Gyro	STUDENT LET Feedback H/M	LET Feedback Seconds (Quad)	LET Feedback Gyro	H/M	<-- --> L-R	Gyro Score
__	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	H/M	---	_/_
__	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	H/M	---	_/_
__	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	H/M	---	_/_
__	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	H/M	---	_/_
__	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	H/M	---	_/_
__	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	H/M	---	_/_
__	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	H/M	---	_/_

Y / N Instructor coached the student during LET qualification.

COMMENTS: (e.g., student problems, instructor comments, special interactions between instructor and student, variation in training procedures, etc.)

Key to LET Observation Form

INSTRUCTOR:

= Sequence number of round fired.

Before
Watch Gunr = Did the instructor watch the student before the shot, when preparing to fire?
Fdbk = Did the instructor give the student feedback when preparing to fire?

During
Watch Gunr = Did the instructor watch the student after the LET was fired, when the target was being tracked?
Feedbk Gunr = Did the instructor give the student feedback about firing position during the track?
Feedbk Gyro = Did the instructor give the student feedback about aiming during the track based on the indicator meter reading?

LET Feedback
H/M = Did the instructor tell the student "hit" or "miss"?
Seconds = When the student received a miss, did the instructor tell the student during which second of flight the error was made?
Gyro = Did the instructor tell the student the final indicator meter score?

STUDENT:

H/M = Did the student hit or miss the target?

<--
--> = In which direction was the vehicle traveling?
L-R

Gyro Score = What was the indicator meter score (horizontal/vertical readings)?

APPENDIX C

EXAMPLE OF DRAGON STUDENT OBSERVATION FORM

Student: _____ Observer: _____ Date _____

PREPARE THE M47 MEDIUM ANTITANK WEAPON SYSTEM FOR FIRING

Time practice/test started: _____ Time practice/test ended: _____
Number of practice/test trials: ____ Trial received GO: 1 2 3

	Content	GO			NOGO		
		1	2	3	1	2	3
	ROUND:						
1	Unsnap bipod retaining strap.						
2	Push bipod forward until resistance is met, then slap off the forward shock absorber.						
3	With the FHT, ensure bipod brace is locked.						
4	While holding round, push bipod legs downward to number 4 or 5.						
5	Release friction lock.						
6	"I am removing the electrical connector cover from the round."						
7	Select firing position (sit, stand, kneel, prone).						
	DAY TRACKER:						
8	Pull carrying bag flap open.						
9	Hold open with right hand.						
10	Grasp tracker by optical tube (telescope barrel) or trigger mechanism, and remove from bag.						
11	Do not lift tracker by shock absorbers.						
12	Do not touch lens.						
13	"I am visually inspecting the lens."						
14	Remove electrical connector cover from electrical connector and secure cover on velcro.						

	Content	GO			NOGO		
		1	2	3	1	2	3
	MATE:						
15	Place guide pins in slots of tracker bracket guide rail.						
16	Push tracker firmly to the rear using both hands until spring clip locks the guide pin in place.						
17	Shake tracker to ensure it is locked in place.						
18	Remove lens cover and secure to top of forward shock absorber.						
19	Visually inspect the lens for damage or obstruction.						
20	Did not press safety and trigger while mating.						
21	Adjust for height and level sight picture.						
22	Look to see if there is a level sight picture.						
22	Adjust bipod friction lock and foot adjust to obtain a level sight picture.						
24	"I have obtained a level sight picture."						

TEST ONLY:

25 Y/N Instructor asked leading questions to help the student pass the test.

26 Y/N Would you have passed this student?

27 Y/N Instructor stopped student when a mistake was made.

28 Y/N Instructor told student he made a mistake, but student was allowed to continue with the task.

29 Y/N Other occurrences (unusual weather, unexpected instructor assignments)?

APPENDIX D

EXAMPLE OF INSTRUCTOR CERTIFICATION TRAINING MATERIALS

DRAGON INSTRUCTOR CERTIFICATION PROGRAM

INSTRUCTOR MATERIALS

Training objective: Prepare an antiarmor range card.

Conditions: During daylight, given an antiarmor weapon system, a designated firing position, a sector of fire, target reference data, DA Form 5517-R, pencil, protractor (GTA 5-2-12), and compass.

Standards: Prepare a range card that includes a data section and a sketch section of the sector of fire, with appropriate sketches and military symbols.

REQUIRED TRAINING AIDS

Butcher paper or chalk board
Minivillage
Compass mock-up
Compass for each instructor
Protractor (GTA 5-2-12) for each instructor

TRAINING TIPS

State purpose of block of instruction.

This tells the student what he must be able to do.

Define/clarify key terms/concepts.

Acronyms are a common part of this task. Make sure they are known and clearly understood. Additionally, there are many parts to the range card, which tax the memory.

Present rule(s)

This task uses rules which are not unique to antiarmor weapons, those which should have been learned previously (for example, back azimuth). Do not assume they have been learned and can be applied to a new situation. Remember to review the rules thoroughly.

Provide practice

Students learn when they are presented varied practice situations. Vary distances, azimuths, and/or reference points, or vary the terrain on which they practice.

Feedback

Feedback allows students the opportunity to learn from their mistakes. If a practice exercise is given, then take the time to grade it and allow the student time to review the corrected exercise.

Teach

Provide a logical order to the ten required parts of the range card. Explain to the students what the order is, and why the order should be followed.

****

1. State purpose of block of instruction.

To prepare an antiarmor range card.

Instructor's note: Explain the importance and purpose of a range card. Additionally, explain or identify the common elements (that is, used for all direct fire weapons, all will have a direction, range, and description, etc.) across weapon systems.

2. Define/clarify key terms/concepts

Sector of fire
    Left limit
    Right limit
Maximum engagement line (max eng line)
Gunner reference point (GRP)
    Back azimuth
Anticipated target engagement areas (ATEA)
Target reference point (TRP)
Dead space
Dragon weapon symbol
Magnetic north
Marginal information
    Unit (not above company)
    Primary (alternate or supplementary) position identification
    Date
    Time
    Meter equivalent

Instructor's notes: This is a lot of information, with acronyms and abbreviations. Provide the students with a strategy to remember and accurately record all the information on the range card. An approach to simplifying the transfer of information from the top of the form to the bottom is to work back and forth between the two halves. That is, when number 1 (left limit) is identified and circled on the sector sketch, move to the bottom of the form and supply the information in the data section. Continue this until all information is supplied.

Another approach may be to fill in all the known information (marginal information, weapon symbol, meter equivalent, etc.) first. Then progress to the sector sketch and data section information.

Provide logic for the information which is used on the range card. The reason the weapon symbol is used rather then the word "Dragon" is not so the Threat will not understand the information, but because the symbol is a universal NATO symbol for medium distance antitank weapons.

3. Present rules

Slowly and clearly explain how to determine a back azimuth. Math skills are also important for determining the meters between circles.

Instructor's notes: Remember that not all students have good math skills. Take your time. Show and explain to the students how you determined the back azimuth as well as the division for determining the distance between circles.

4. Provide practice

When practicing this task, the demonstration example should be different from the practice example(s), which in turn, should differ from the test example; vary azimuths, distances, and reference points, or the terrain on which the task is practiced.

Instructor's notes: The student has many and varied things to do to successfully complete this task. He must have math skills, the ability to mentally picture the minivillage so it can be drawn, compass skills, as well as the knowledge of all the elements. Make sure there is time for two practice exercises.

When you use the minivillage for your examples and the test, change the location of the ATEA and TRP. Change the azimuths of the left and right limits, as well as the distance to the village from the gunners location. For the test, use the actual azimuths and allow the students to use the compass which has been issued to the instructor.

Use another piece of terrain for practice. The range card could be drawn from the LET firing position to down range. Make the exercise realistic.

5. Feedback

The student needs thorough feedback after each practice trial, because of the many elements in this task.

Instructor's notes: Grade the practice trials as you would the test trial, mark all errors. Ask the student if he knows why the error is an error. Explain to him and the other students in the group why the error is an error.

APPENDIX E

EXAMPLE OF INSTRUCTOR CERTIFICATION EVALUATION PROCEDURES

INSTRUCTOR CERTIFICATION TEST FOR PREPARE AN ANTIARMOR RANGE CARD

1. Assessment of ability to instruct

Instructor objective: Instruct students on how to prepare an antiarmor range card.

Conditions: Given a chalkboard, chalk, DA Form 5517-R, a compass, protractor (GTA 5-2-12), and audience.

Standards: Instruct student to properly prepare and use an antiarmor range card. The instructor has two attempts to successfully complete this task. Instruction must include the following parts:

Instructor: _____ Date: _____

	Trial 1	Trial 2
State purpose of block of instruction.	GO / NOGO	GO / NOGO
Clear (understandable) sector sketch	GO / NOGO	GO / NOGO
Clear definition of terms:		
Sector of fire	GO / NOGO	GO / NOGO
Left limit	GO / NOGO	GO / NOGO
Right limit	GO / NOGO	GO / NOGO
Maximum engagement line	GO / NOGO	GO / NOGO
Gunner reference point (GRP)	GO / NOGO	GO / NOGO
Back azimuth	GO / NOGO	GO / NOGO
Anticipated target engagement areas (ATEA)	GO / NOGO	GO / NOGO
Target reference point (TRP)	GO / NOGO	GO / NOGO
Dead space	GO / NOGO	GO / NOGO
Dragon weapon symbol	GO / NOGO	GO / NOGO
Magnetic north	GO / NOGO	GO / NOGO
Marginal information		
Unit (not above company)	GO / NOGO	GO / NOGO
Primary (alternate or supplementary) position identification	GO / NOGO	GO / NOGO
Date	GO / NOGO	GO / NOGO
Time	GO / NOGO	GO / NOGO
Meter equivalent	GO / NOGO	GO / NOGO

2. Assessment of ability to identify student errors, analyze reason for error and correct.

Instructor objective: To analyze, evaluate and correct student performance on preparing an antiarmor range card.

Condition: Given 5 Dragon range cards and pencil. [Only 1 range card with student errors is presented for illustrative purposes.]

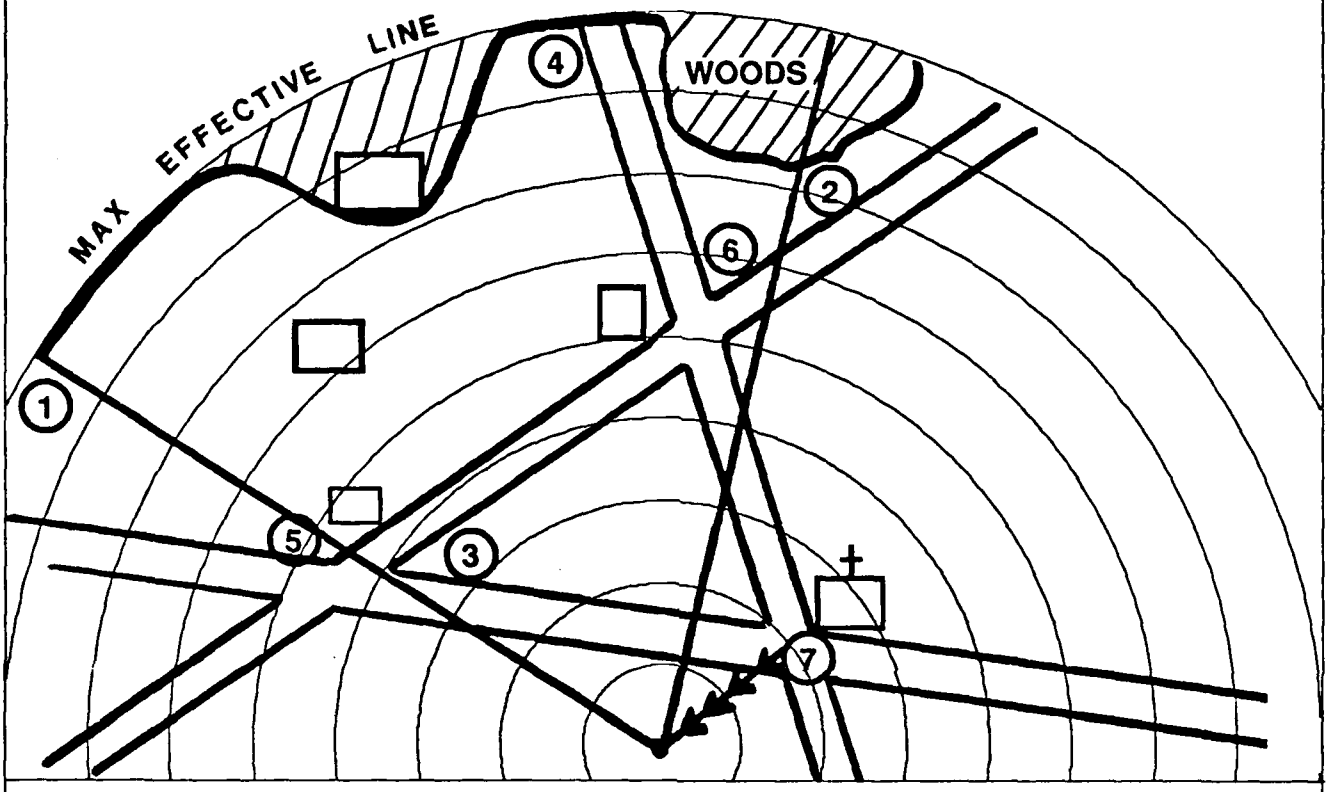
Standard: Identify and correct all the errors on the test range cards. The instructor will have two trials to successfully complete this task.

Test problems (with answers):

	Trial 1	Trial 2
1. Range card # 1.		
Errors on range card:		
Magnetic north arrow pointing in wrong direction.	GO / NOGO	GO / NOGO
Dead space not drawn for all areas.	GO / NOGO	GO / NOGO
Maximum engagement line is not labeled properly.	GO / NOGO	GO / NOGO
Correction of errors:		
Gunner should be reminded that the magnetic north arrow must be drawn relative tc the azimuths provided for the left and right limit. Provide another (different) example. (Note: A protractor may be an appropriate training aid if this is a persistent problem. Another technique is to draw a circle and place the left and right limits at their appropriate azimuths to show where magnetic north would be.)	GO / NOGO	GO / NOGO
Explain the purpose for identifying dead space and how it is determined. The gunner can not engage a target if dead space is in the anticipated target engagement area.	GO / NOGO	GO / NOGO
Explain that although the maximum effective distance is 1000 m, the 1000 m line is marked as the maximum engagement line because targets can not be engaged beyond that point.	GO / NOGO	GO / NOGO

STANDARD RANGE CARD

SQD 3 PLT 2 CO B	May be used for all types of direct fire weapons	MAGNETIC NORTH



DATA SECTION

POSITION IDENTIFICATION	PRIMARY	DATE	1700 HRS 12 JAN 89
WEAPON		EACH CIRCLE EQUALS METERS	111

NO.	DIRECTION/ DEFLECTION	ELEVATION	RANGE	AMMO	DESCRIPTION
1	122°		1000 m		LEFT LIMIT
2	194°		800 m		RIGHT LIMIT
3	115°		460 m		ATEA #1
4	175°		1000 m		ATEA #2
5	115°		460 m		TRPA1 ROAD JUNCTION
6	185°		570 m		TRPA2 ROAD JUNCTION
REMARKS:					
7	50°		222 m		KNOWN POINT ROAD JUNCTION

DA Form 5517 R

1

APPENDIX F

DESCRIPTIVE DATA ON INSTRUCTOR BEHAVIOR

Table 7

Total Instructional Time in Minutes for Pre- and Post-Certification Phases

	Pre		Post	
Task	M	SD	M	SD
Experimental				
Malfunctions	37.2	11.4	64.4	38.4
Engageability	36.4	11.1	46.8	15.6
Prepare	30.2	13.3	37.3	9.9
Range Card	64.9	11.8	78.3	15.8
Sum	168.7		226.8	
Control				
AN/TAS-5	56.2	11.9	68.3	15.9
Maintain	57.2	12.1	73.5	19.6
Restore	23.3	14.7	21.0	10.3
Fighting Position	36.8	21.2	39.0	16.5
Firing Position	39.1	5.5	36.1	9.8
Sum	222.6		237.9	

Note. LET instruction excluded from table, because time required for firings controlled by target vehicle, not the instructor.

Table 8

Mean Percentage of Content Items Presented by Instructors during Pre- and Post-Certification Phases

Task	# Items	Pre	Post
Experimental			
Malfunctions	55	96.9	96.7
Engageability	11	97.9	100.0
Prepare	24	92.0	92.3
Range Card	24	98.2	98.3
LET	17	83.8	83.3
All Tasks*		93.8	94.1
Control			
AN/TAS-5	43	92.9	94.0
Maintain	34	88.8	85.5
Restore	29	96.2	87.3
Fighting Position	38	69.3	74.8
Firing Position	42	88.5	95.5
All Tasks*		87.1	87.4

* Each task weighted equally in computation of mean.

Table 9

Mean Percentage Use of Critical Instructional Techniques during Pre- and Post-Certification Phases

Task	Phase	Instructional Techniques: Same Terms	Correct Errors	Training Aids	Memory Cues	Key Points	All Behaviors
Experimental							
Mal-functions	Pre	92.3	84.6	84.6	7.7	61.5	66.1
	Post	100.0	91.7	91.7	16.7	66.7	73.4
Engage-ability	Pre	100.0	53.8	53.8	23.1	92.3	64.6
	Post	100.0	84.6	92.3	100.0	92.3	93.8
Prepare	Pre	100.0	72.7	81.8	36.4	63.6	70.9
	Post	100.0	78.6	64.3	50.0	78.6	74.3
Range Card	Pre	100.0	58.3	100.0	58.3	58.3	74.9
	Post	100.0	83.3	71.4	57.1	85.7	81.5
All Tasks	Pre	98.1	67.4	80.1	31.4	68.9	69.2
	Post	100.0	84.6	79.9	55.9	80.8	80.8
Control							
AN/TAS-5	Pre	100.0	90.9	100.0	27.3	90.9	81.8
	Post	100.0	100.0	100.0	28.6	85.7	83.1
Maintain	Pre	100.0	72.7	90.9	72.7	36.4	74.5
	Post	91.7	83.3	100.0	83.3	66.7	85.0
Restore	Pre	90.0	80.0	60.0	0.0	80.0	62.0
	Post	91.7	83.3	83.3	8.3	66.7	66.7
Fighting Position	Pre	91.7	83.3	75.0	33.3	50.0	66.7
	Post	100.0	85.7	85.7	28.6	28.6	65.7
Firing Position	Pre	92.3	100.0	69.2	30.8	92.3	76.9
	Post	100.0	84.6	61.5	15.4	46.2	61.5
All Tasks	Pre	94.8	85.4	79.0	32.8	69.9	72.4
	Post	96.7	87.4	86.1	32.8	58.8	72.4

Table 10

Mean Percentage Use of Instructional Techniques Unique to Tasks during Pre- and Post-Certification Phases

Task	Techniques	# Questions	Pre	Post
Experimental				
Malfunctions	Define Terms	4	78.8	97.9
	Rationale	8	69.2	69.8
Engageability	Define Terms	9	89.7	99.1
	Use Examples	3	64.1	64.1
	Reticle Aids	2	34.6	76.9
Prepare	Define Terms	2	54.5	42.9
	Procedures	5	92.7	80.0
Range Card	Define Terms	9	99.1	100.0
	Calculations	2	95.9	92.9
Control				
AN/TAS-5	Define Terms	8	68.8	62.5
	Procedures	2	81.8	78.6
Maintain	Define Terms	8	71.6	75.0
Fighting Position	Define Terms	4	56.3	57.2

APPENDIX G

ANALYSIS OF VARIANCE TABLES: LET INSTRUCTOR BEHAVIOR

Table 11

ANOVA on LET Instruction: Watch Student before Firing

Source	df	SS	MS	F	p
Between Subjects					
Pre-Post Certification	1	186.25	186.25	2.90	0.0916
Subjects within Pre-Post	98	6287.81	64.16		
Within Subjects					
Block of LET Firings	7	1718.04	245.43	31.46	0.0001
Block x Pre-Post	7	120.14	17.16	2.20	0.0327
Block x Subjects within Pre-Post	686	5350.79	7.80		

Table 12

ANOVA on LET Instruction: Feedback before Firing

Source	df	SS	MS	F	p
Between Subjects					
Pre-Post Certification	1	45.13	45.13	1.31	0.2250
Subjects within Pre-Post	98	3373.80	34.43		
Within Subjects					
Block of LET Firings	7	4090.58	584.37	77.50	0.0001
Block x Pre-Post	7	60.64	8.67	1.15	0.3315
Block x Subjects within Pre-Post	686	5172.54	7.54		

Table 13

ANOVA on LET Instruction: Watch Student during Tracking

Source	df	SS	MS	F	p
Between Subjects					
Pre-Post Certification	1	5.95	5.95	0.10	0.7508
Subjects within Pre-Post	98	5748.30	58.66		
Within Subjects					
Block of LET Firings	7	1670.94	238.71	31.83	0.0001
Block x Pre-Post	7	131.06	18.72	2.50	0.0156
Block x Subjects within Pre-Post	686	5144.88	7.50		

Table 14

ANOVA on LET Instruction: Feedback on Position during Tracking

Source	df	SS	MS	F	p
Between Subjects					
Pre-Post Certification	1	306.28	306.28	5.39	0.0224
Subjects within Pre-Post	98	5573.08	56.87		
Within Subjects					
Block of LET Firings	7	1467.51	209.64	25.80	0.0001
Block x Pre-Post	7	84.69	12.10	1.49	0.1688
Block x Subjects within Pre-Post	686	5574.66	8.13		

Table 15

ANOVA on LET Instruction: Feedback on Aiming during Tracking

Source	df	SS	MS	F	p
Between Subjects					
Pre-Post Certification	1	168.36	168.36	3.02	0.0853
Subjects within Pre-Post	98	5460.76	55.72		
Within Subjects					
Block of LET Firings	7	557.03	79.57	10.64	0.0001
Block x Pre-Post	7	274.11	39.16	5.24	0.0001
Block x Subjects within Pre-Post	686	5129.54	7.48		

Table 16

ANOVA on LET Instruction: Feedback on Aiming after Firing/Tracking

Source	df	SS	MS	F	p
Between Subjects					
Pre-Post Certification	1	72.00	72.00	6.16	0.0147
Subjects within Pre-Post	98	1144.56	11.68		
Within Subjects					
Block of LET Firings	7	654.02	93.43	28.09	0.0001
Block x Pre-Post	7	58.26	8.32	2.50	0.0154
Block x Subjects within Pre-Post	686	2282.04	3.33		

Table 17

ANOVA on LET Instruction: Feedback on Tracking Error (if Target Miss)

Source	df	SS	MS	F	p
Between Subjects					
Pre-Post Certification	1	10.58	10.58	1.04	0.3111
Subjects within Pre-Post	98	1000.23	10.21		
Within Subjects					
Block of LET Firings	7	828.26	118.32	32.60	0.0001
Block x Pre-Post	7	75.54	10.79	2.97	0.0044
Block x Subjects within Pre-Post	686	2486.61	3.63		

Table 18

ANOVA on LET Instruction: Inform Student of Target Hit or Miss

Source	df	SS	MS	F	p
Between Subjects					
Pre-Post Certification	1	486.72	486.72	12.48	0.0006
Subjects within Pre-Post	98	3822.57	39.01		
Within Subjects					
Block of LET Firings	7	46.84	6.69	1.83	0.0723
Block x Pre-Post	7	64.10	9.16	2.51	0.0133
Block x Subjects within Pre-Post	686	2504.95	3.65		

Table 19

Means on Instructor Behaviors during LET Training: Firing Trial by Certification Phase

	Practice		Qualify	
Instructor Behavior	Pre	Post	Pre	Post
Watch Student before Firing	6.4	7.4	3.7	4.6
Feedback before Firing	6.5	6.8	1.9	2.5
Watch Student during Tracking	4.4	4.5	2.0	2.3
Feedback on Position during Tracking	5.1	5.9	2.2	3.6
Feedback on Aiming during Tracking	4.0	4.3	1.8	3.4
Feedback on Aiming after Firing/Tracking	2.3	1.3	0.5	0.3
Feedback on Tracking Error (if Target Miss)	2.6	2.2	0.9	0.9
Inform Student of Target Hit or Miss	7.9	9.2	7.8	9.6

APPENDIX H

STUDENT MEASURES

Table 20

Means on Student Measures by Certification Phase

Task	Pre-Certification	Post-Certification
Original Classes		
GT Score	105.0	103.5
LET-Sitting, Practice	11.3	11.7
LET-Standing, Practice	14.0	15.7
LET-Sitting, Qualification	17.3	17.2
LET-Standing, Qualification	17.2	17.5
Retention		
GT Score	109.1	104.2
Range Card Steps Recalled	18.6	20.3
Prepare Steps Recalled	18.4	17.4
Malfunctions Steps Recalled	33.3	28.1
Maintain Steps Recalled	18.6	20.3

Note. Maximum scores: LET position = 20; Range Cards steps = 24; Prepare steps = 24; Malfunction steps = 51; Maintain steps = 23.

analyses. The mean GT scores for the students tested during the retention phase varied by week with Week 2 scores higher than Week 4 ($F(3, 73) = 3.01$, $p<.04$; $M_{Wk2} = 109.3$ and $M_{Wk4} = 99.3$).

The percentage of students who retained all steps on each task was low, less than 6%. In contrast, upon completing the Dragon course, each student recalled 100% of the steps on each task. In addition, the overall retention rates for the tasks differed. The lower level for Malfunctions is shown in Figure 1. On Malfunctions, only 65% of the students recalled at least half the steps, while 98% of the students recalled at least half the steps on the other tasks. Because the GT scores on the Dragon classes differed for the students tested for retention and GT correlated with over-all retention (Table 6), an analysis of covariance was performed to determine pre-post differences. Range Card showed statistically significant pre- to post increases ($F(1,74) = 8.76$, $p<.004$, $M_{Pre} = 18.4$ and $M_{Post} = 20.6$). Post-certification recall was also higher for Maintain ($F(1,57) = 16.97$, $p<.0001$, $M_{Pre} = 17.5$ and $M_{Post} = 20.3$). No significant differences occurred on Prepare and Malfunctions.

Relationships among Student Measures

A correlational analysis was performed with the following variables: GT score, LET practice and qualification scores, the number of first-trial GOs on the other tasks, and the sum of the retention scores. GT score correlated significantly with first-trial GO, LET practice score, and retention scores (see Table 6). LET practice correlated with LET qualification and first-trial GO.

Table 6

Correlations among GT Score, LET Practice and Qualification, First-Trial GO, and Retention Scores

	LET Practice	LET Qualification	GO	Retention
GT	.22*	.12	.24*	.47**
LET Practice		.56**	.38**	.06
LET Qualification			.15	.00
GO				.19

* $p<.05$; ** $p< .001$

Note. Correlation coefficients were based on an N of 104, except for those involving retention scores which were based on an N of 60.

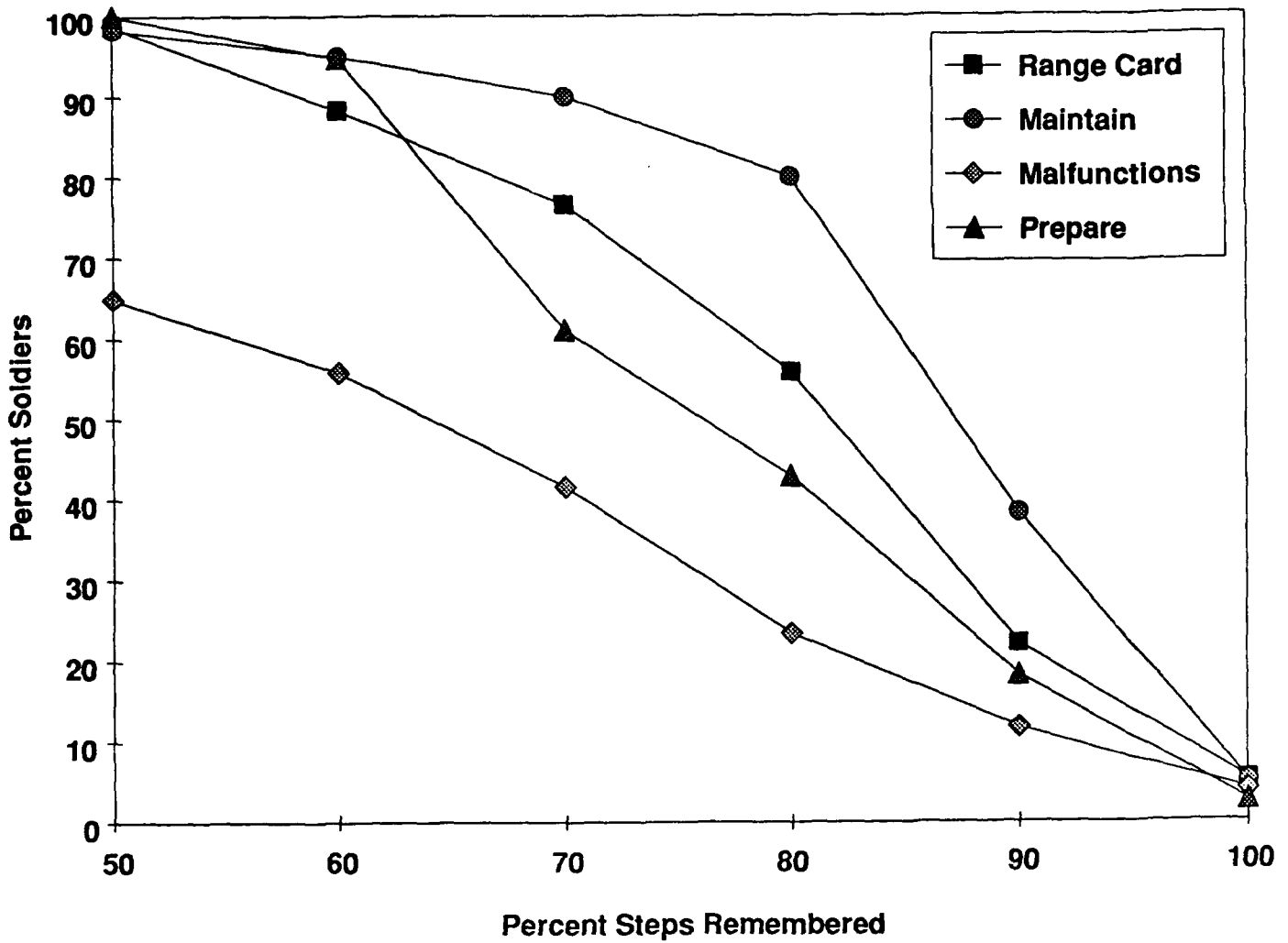


Figure 1. Retention results on maintain, range card, prepare, and malfunctions (3-4 week retention interval)

Relationships between Instructor and Student Behavior

Post hoc, it was decided to determine if instructor behavior, regardless of certification training was related to student behavior. On tasks other than the LET, four variables were selected as discriminators of instructor behavior: time to describe the task, time allowed for students to practice the task, number of task elements presented to the students, and adherence to principles of instruction (e.g., feedback, memory cues, training aids). It was assumed that student performance would be enhanced when instructors took more time to describe the task, and when students had more practice trials. Additionally, the quality of the instruction, determined by the instructor's presentation of the material, and the feedback and guidance given to students, should also affect student behavior (Berliner, 1979).

Instructors were ranked on these variables by the following procedure. The mean and standard deviation for each variable on each Dragon task were calculated. Then the relative position of each instructor to the mean on each task was determined. For each task, an instructor was assigned 2 points for being above the average of all instructors on at least three of the four instructor variables. A value of 1 was given if an instructor was above the mean on two instructor variables and below it on the other two variables. A value of 0 was assigned if an instructor was below the mean on at least three of the four variables. For each instructor these values were summed across the Dragon tasks; high values reflected "better" instruction. In order to equate for the number of tasks taught by each instructor, the sum was divided by the number of tasks taught.

The instructor behavior ratios were converted to ranks, as was the percentage of students taught by each instructor who passed all tasks on the first trial. The Spearman rank order correlation between these two indices with instructor scoring of student task performance was .19. On the other hand, the correlation was .57 ($p<.05$) with observer scores of student performance. Further analysis of the instructor behavior ratio indicated that instructors who ranked low on this index were most likely to be the ones with whom observers disagreed on student scores. In fact, 75% of the instructor-observer discrepancies were accounted for by the instructors with the three lowest ranks. This association explains the difference in the magnitude of the two rank order correlations. In addition, these data indicate that instructors who were weak in the delivery of content and in their guidance to students also tended to be poor evaluators of student performance.

Seven factors were used to identify good and poor instructor behaviors during LET firing. For practice trials, the factors were: watched the student before the LET was fired, gave the student feedback before firing, watched the student track, gave performance feedback while tracking, told the student "hit" or "miss," and provided time of flight error feedback when the student missed. For qualification trials, the only instructor behavior used was whether the student was told "hit" or "miss," since instructors were not supposed to coach during qualification.

Instructors were ranked on these factors using the block firing data on the LET. The mean for each factor was calculated for each of the four practice blocks and the

four qualification blocks. The relative position of each instructor to the instructor average was determined for each block. A value of 1 was assigned if an instructor was above the mean; a 0 if below. The sum of these scores across the blocks of firings for each variable was computed. A high score indicated the instructor provided more feedback or observed gunners more frequently than the typical instructor. The sum of these scores across the seven desired instructor behaviors was calculated for each instructor, and the sums converted to ranks to obtain an index of instructional quality with the LET.

The LET performance of students assigned to each instructor was assessed by four measures of hit performance: practice trials in the sitting and standing supported positions, and qualification in the same two positions. The number of hits from each of these positions and conditions was converted to ranks, and correlated with the LET instructor behavior index. The correlations ranged from -.33 to +.09; none was significant.

Also of interest was whether instructors who demonstrated desired behaviors on the LET demonstrated desired instructional behaviors when teaching the other tasks as well. The rank order correlation between the two indices of instructor quality was .61 ($p < .05$).

Discussion

Instructor Behavior

Practice and providing students feedback were instructor behaviors emphasized during certification because of their determined value during training (Brophy & Good, 1986; Gagne, 1977; Riegeluth, 1987). Changes in practice time and feedback as well as other desired instructional techniques after the certification program favored the experimental tasks. Total time devoted to the experimental tasks increased. The incidence of corrective feedback during LET training and the other task instruction increased; memory cues increased; critical points, concepts and procedures were more likely to be stressed. A clear illustration of direct transfer from the certification program to actual Dragon instruction was in the use of the night tracker training aid developed for instruction on Target Engageability. Inconsistent changes and little change on such instructional techniques were characteristic of control task instruction.

Despite the changes associated with the certification program, certain improvements could be made. Memory cues, including mnemonics and strategies for remembering procedures or concepts, were used less than half the time during task instruction, and not used consistently across tasks. These trends may explain, in part, the low percentage of task steps recalled during retention Apparently, instructors did not stress ways of retaining the material over a long period of time. They focused primarily on ensuring students succeeded in passing the end-of-course test. The learning environment was not structured to facilitate long-term recall. The student was taught the task, practiced it several times (if needed), and was then tested. When the student failed, a retest was given immediately. If a student received a second failure, the

student was told to study and was retested on the following day. Thus, the longest time a student was required to remember the information for the test was typically about an hour, and rarely was it more than a day.

Some instructional techniques were used more frequently (from 68% to 85% of the time), but improvements to the certification program could probably increase their incidence as well. Examples of these techniques were feedback/error correction, use of training aids, and emphasis of critical points. On the other hand, instructors almost always used the same terms within a block of instruction (95% to 100%). This high rate may have occurred because the students were tested on their use of terms (e.g., names of Dragon parts). This student requirement may have caused the instructors to use terms consistently, rather than the certification program per se.

It may be that some instructional techniques are relatively unfamiliar to individuals with relatively little formal training in how to teach but with considerable teaching experience, such as the Dragon NCO population in the present research. As a result these techniques may be more difficult to learn and apply. Special instructional procedures in a certification program may be needed to ensure mastery and to convince instructors of their importance. Several findings support this hypothesis. Use of memory cues and providing feedback were both stressed within the certification program. However, instructors were more apt to provide feedback than to use memory cues. In addition, the certification training results indicated that it was easier for new instructors to master task content, than to diagnose and correct student errors. The greater ability of the current NCOs to diagnose and correct errors may reflect the importance of teaching experience as a means of acquiring this skill. These results are consistent with Anderson, Evertson, and Brophy's (1979) finding that teachers were more likely to implement some principles of instruction than others.

Student Performance

The only significant changes in student performance from pre- to post-certification occurred on three experimental tasks: Prepare to Fire, Determine Target Engageability, and LET practice trials from the standing supported position. One possible explanation for the positive results on Prepare and Engageability is the novelty and distinctiveness of the certification training materials. The Prepare training materials consisted of a special booklet formatted in a style familiar to the military. Drawings and graphics supplemented the text to increase interest in the materials. For Engageability, special training aids, consisting of the day and night tracker reticles, and drawings of vehicles at various aspects and ranges and in combat settings, were constructed. The instructional materials stressed using these aids to present sufficient examples of the engageability rules and concepts.

The pre-post change in LET performance may be attributed to inherent task properties. LET firings from the standing supported position are harder than from the sitting position (U.S. Army Combat Developments Experimentation Command, 1979; U.S. Army Infantry Board, 1972). Thus, there may have been more opportunity for instructor interaction (e.g., corrective feedback) which led to improved student performance during practice. The difficulty of the standing supported position is masked

in the present research because of sequential learning effects associated with the repeated LET trials (sitting trials preceded standing supported trials, see Appendix H).

Two possible reasons for the lack of pre-post certification effects on Range Card and Malfunctions are task difficulty and the certification materials. Range Card had the lowest percentage of first-trial GOs. It requires a variety of skills: both compass and mathematical skills, and attention to accuracy and detail. Although the first-trial GO rate on Malfunctions was not unusually low, this task is difficult. Fifty-one steps must be recalled in an exact sequence, and the steps do not cue each other. Thus, the apprehending and feedback phases of learning (Gagne, 1977) may not have been adequately facilitated during instruction. Additional support for the difficulty of this task was found during retention testing. Student performance was lowest on Malfunctions, with only 65% of the students recalling at least half of the steps. In addition, the certification materials for these tasks were not as distinctive as those for Engageability and Prepare. As a result they may not have been sufficiently powerful to help instructors reduce the problems students had with the Malfunctions task.

A third contributing factor to Range Card performance could be the teaching conditions. During post-certification, the weather became exceptionally severe. Temperatures were very low and the wind chill made the ambient temperature even colder. To protect the soldiers from the severe weather conditions, Range Card was taught differently than during pre-certification. Instead of the usual small group instruction, one instructor taught the entire class in a small over-crowded room. The students then practiced in the same crowded environment, with interference from the other students. Testing also occurred under these conditions.

Finally, another explanation for pre-post increases on only the experimental tasks is possible. The experimental tasks were not selected at random. They were selected to represent a diversity of types of learning. However, as indicated by first-trial GO rates during pre-certification, the experimental tasks were slightly more difficult than the control tasks. Thus the lack of change from pre- to post-certification on the control tasks may have occurred because there was less room for improvement than was the case for the experimental tasks.

It was hoped that pre-post certification effects would be maintained on the experimental tasks tested for retention. Although not all tasks could be examined, such consistency did not occur. For example, Prepare to Fire showed initial pre-post differences, but no retention differences. On the other hand, Range Card and Maintain showed pre-post retention differences, but no initial differences. Thus, there was no consistent positive trend between those students who had been instructed before the instructors received certification training and those who had been instructed after instructor certification.

The most important finding was the low rate of recall for all tasks tested. Overall, the retention results were disappointing. Upon successfully completing the Dragon course, students were able to recall all task steps. However, three to four weeks later, only 6% of these students recalled all steps. Except for Malfunctions, most of the students could remember only half the steps. Not even the four students who had been

"top gun" of their respective classes were able to recall all the steps of the tasks correctly. GT scores correlated positively with retention, indicating that individual retention scores were partially a function of general student ability.

Another problem was discovered during the retention phase. The scoring tools did not provide an adequate way of measuring the inclusion of non-task related information. Many students added steps or information to the tasks. Some of this additional information was caused by interference from similar tasks performed on other weapons. For example, the M60 machine gun also requires a range card, but it is slightly different from the Dragon range card. The students recalled parts of each.

Correlates of Instructor Behavior

The post hoc analyses correlating instructors' use of desired instructional techniques to their students' performance showed fairly strong relationships for all tasks except the LET. In general, instructors who spent more time presenting complete task descriptions, allowed more practice, and adhered to critical instructional principles had students who performed higher than instructors who did not use these procedures. Of special interest, was the fact that the "poorer" instructors were also the "poorer" testers. Tester errors reflected failures to test students on all task steps, and failures to detect student errors. The instructor behavior indices on these tasks and the LET also correlated with each other. However, the LET instructor index did not correlate with students' LET performance. This result is not easily explained, unless the repeated practice trials which were required of all instructors reduced the impact of individual instructor guidance and feedback. It is important to note that both current NCOs and new instructors ranked high and low on both instructor indices.

A final question of interest was whether instructor behavior during the Dragon course could be predicted from certification course performance. Instructor quality indices based on certification tests were generated. The average percentage of content items covered and the average percentage of errors correctly assessed and remediated were used to rank instructors on their proficiency within the certification course. The rank-order correlation between the two instructor indices (i.e., certification performance with Dragon course instruction) on the non-LET tasks was significant ($r = .75$, $p < .05$). The corresponding LET indices did not correlate ($r = .42$). Although the sample was very limited, the data indicate that excellent and poor teachers were identified during the certification program. This finding supports Good and Grouws (1977) findings on a larger sample of elementary mathematics teachers that classroom observers "had no trouble in identifying the relative ineffective teachers" (p. 53).

Summary and Conclusions

The research showed that an instructor certification program tailored to a specific course was feasible and successful. Student performance improved on tasks included in the instructor certification program, and not on the control tasks. Instructors used more of the desired principles of instruction after certification training. In general, the Dragon certification program worked well.

However, if a weapons certification program is to be highly successful, additional research on methods that have powerful effects on modifying instructor behavior is required. The certification program was successful in modifying only certain instructor behaviors, and student performance did not increase on all experimental tasks. New instructors found it difficult to identify and appropriately correct student errors. However, with more instructional experience these skills would probably increase. Task retention was low over a short period of time. The results also indicated a requirement to train instructors on testing procedures.

Future research should also investigate the instructional techniques which should be stressed for the subject matter being taught and the instructor population being trained. Certain techniques were almost always used by instructors regardless of the task and training. Application of other techniques was low and/or varied with the task.

In summarizing the body of literature on teacher behavior and student achievement Brophy and Good (1986) concluded that

> At least two common themes cut across the findings, despite the need for limitations and qualifications. One is that academic learning is influenced by the amount of the time that students spend engaged in appropriate academic tasks. The second is that students learn more efficiently when their teachers first structure new information for them, and help them relate it to what they already know, and then monitor their performance and provide corrective feedback during recitation, drill, practice, or application activities. . . . it now appears that [these generalizations] apply to any body of knowledge or set of skills that has been sufficiently well organized and analyzed so that it can be presented (explained, modeled) systematically and then practiced or applied during activities that call for student performance that can be evaluated for quality and (where incorrect or imperfect) given corrective feedback. (p. 366)

The instructor certification materials developed for the present study emphasized these principles. In addition, the correlational results indicated that students taught by "good" instructors (as defined above) tended to do well compared to students taught by "poor" instructors, regardless of the certification program. Thus, in general, the results support Brophy and Good's conclusions, even though the research was conducted in an environment very different from the educational settings examined in their review.

A certification program can be used effectively to enhance the skills of new and current instructors as well as to select instructors. However, when a program is initiated, commanders must insure that all instructors meet minimum standards, or eliminate those who cannot meet the standards in order to maintain quality instruction.

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